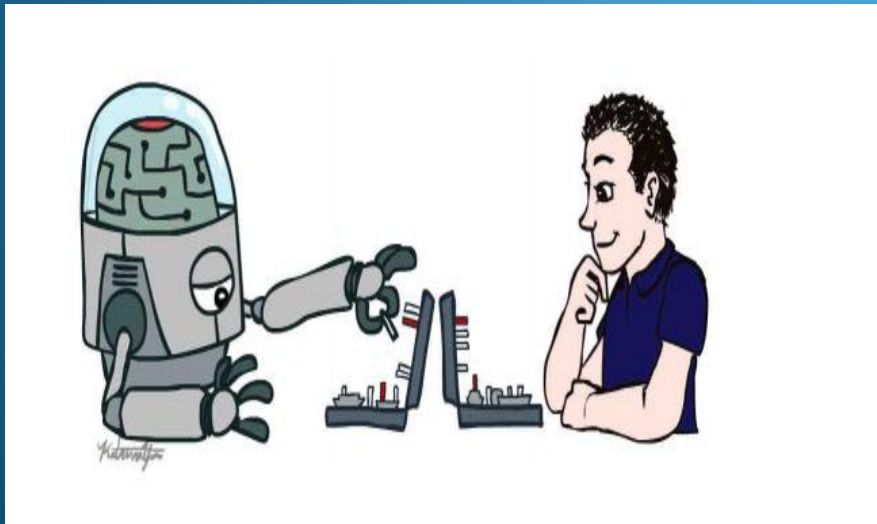


Artificial Intelligence



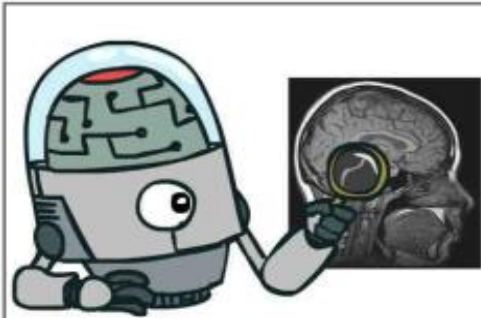
- *What is artificial intelligence?*
- *What can AI do?*
- *What do you expect to learn from this course?*



What is AI?

The science of making machines that:

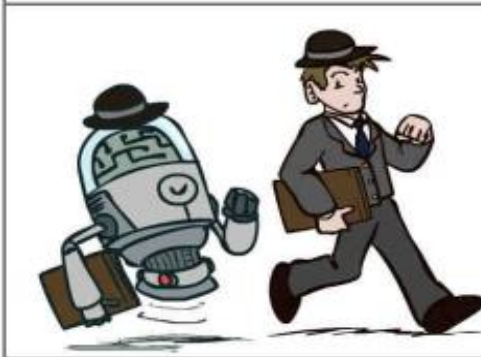
Think like people



Think rationally



Act like people



Act rationally



Rational Decisions

We'll use the term rational in a very specific, technical way:

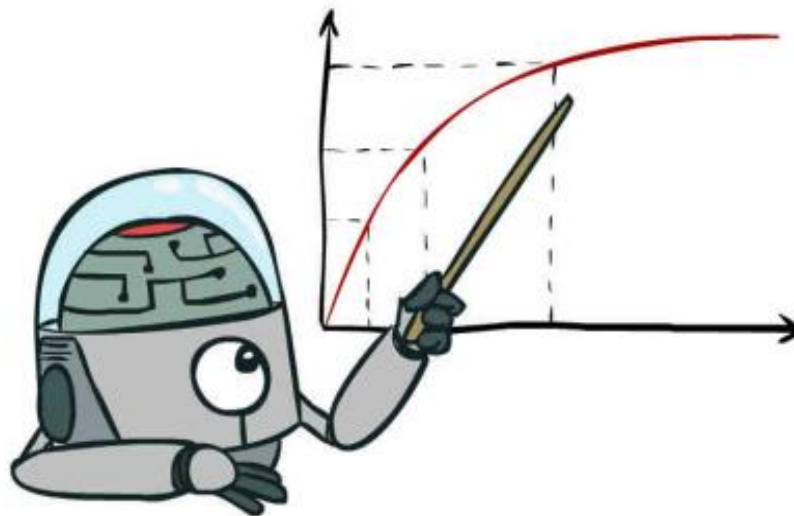
- Rational: maximally achieving your pre-defined goals
- Rationality only concerns what decisions are made
(what you do not the thought process behind them)....

Example: robot vacuum cleaner

- Goals are expressed in terms of the utility of outcomes
Being rational means maximizing your expected utility

Maximize Your Expected Utility...

Maximally achieving your goals.



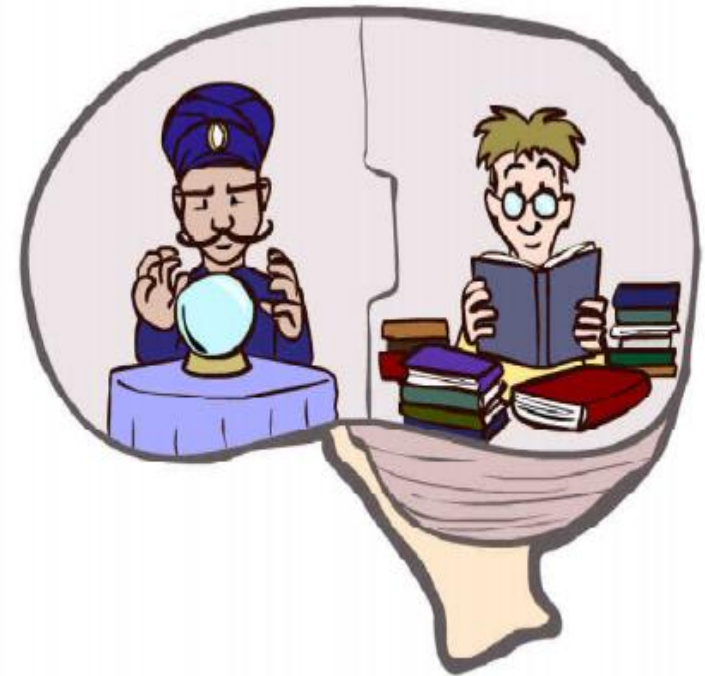
Computational Rationality

What is a utility????

A utility is a function that describes my goals

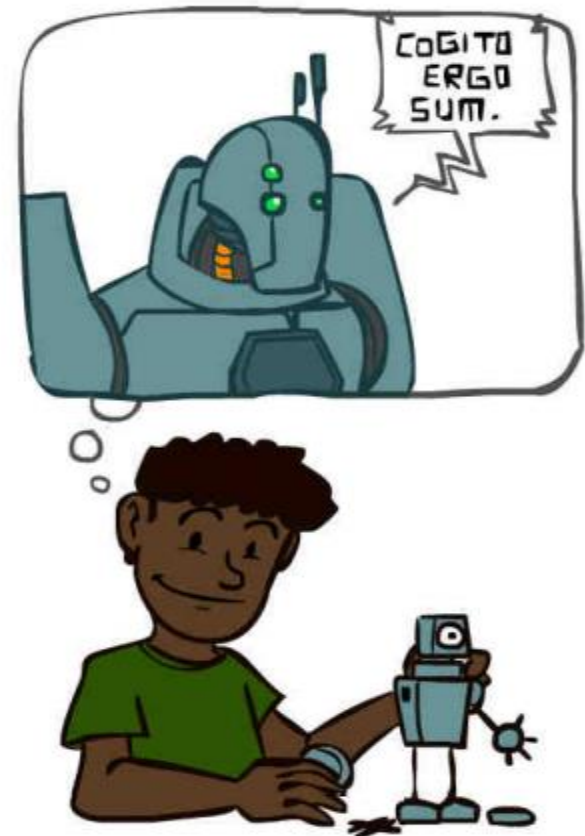
What About the Brain?

- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- “Brains are to intelligence as wings to flight”
- Lessons learned from the brain: memory and simulation are key to decision making

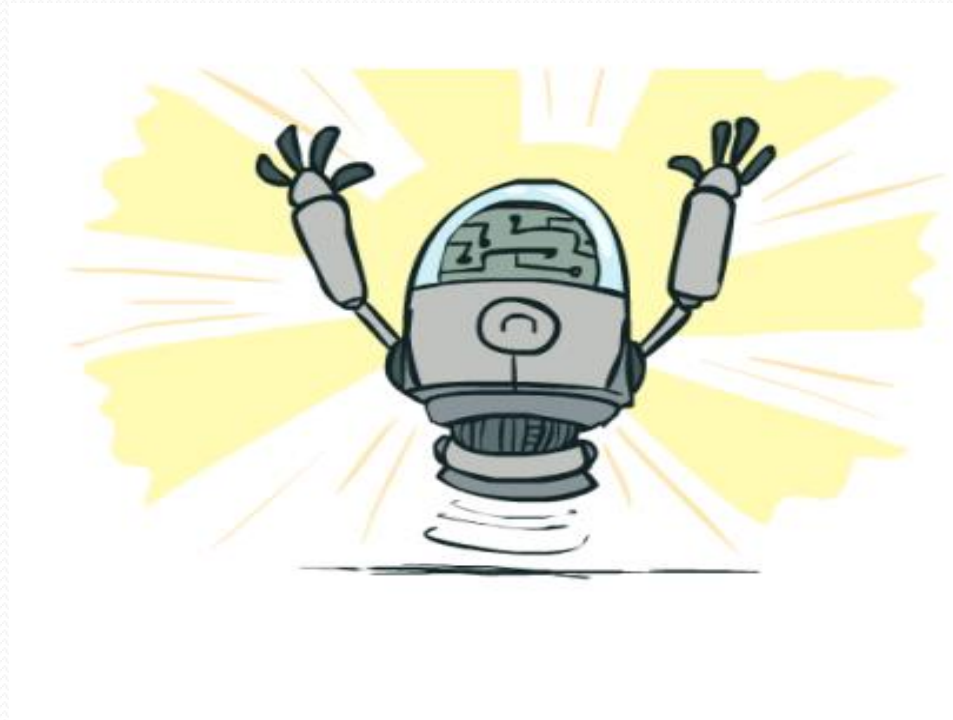


A (Short) History of AI

- 1940-1950: Early days
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement: Look, Ma, no hands!
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
 - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
 - 1965: Robinson's complete algorithm for logical reasoning
- 1970—90: Knowledge-based approaches
 - 1969—79: Early development of knowledge-based systems
 - 1980—88: Expert systems industry booms
 - 1988—93: Expert systems industry busts: "AI Winter"
- 1990—: Statistical approaches
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- 2000—: Where are we now?

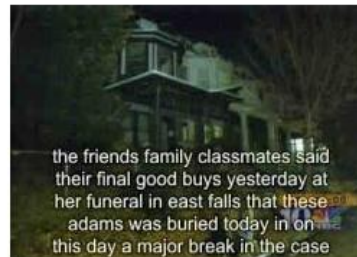


What Can AI Do?



Natural Language

- Speech technologies (e.g. Siri)
 - Automatic speech recognition (ASR)
 - Text-to-speech synthesis (TTS)
 - Dialog systems
- Language processing technologies
 - Question answering
 - Machine translation



"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion tibétaine : la Chine sur ses gardes



"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959

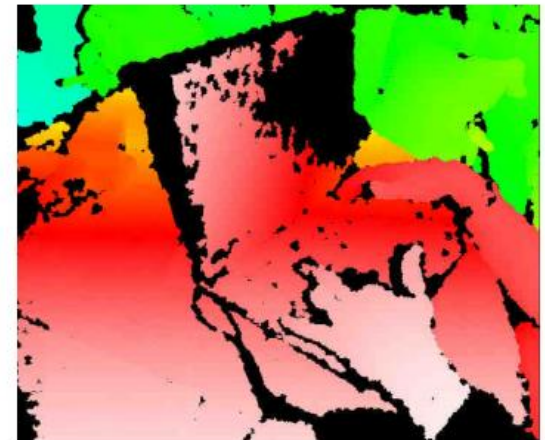
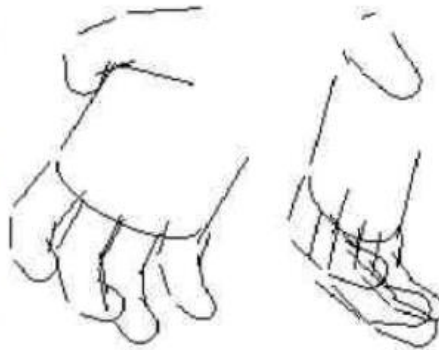
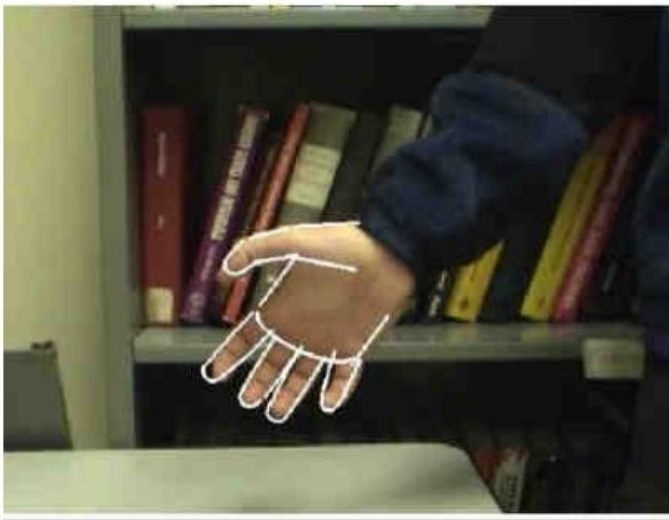
Video Anniversary of the Tibetan rebellion: China on guard



- Web search
- Text classification, spam filtering, etc...

Vision (Perception)?

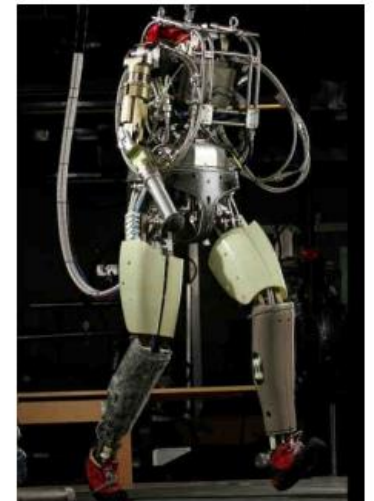
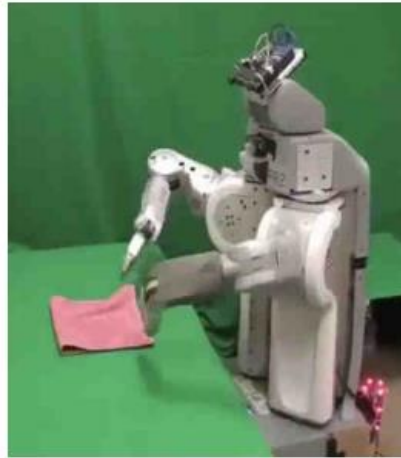
- Object and face recognition
- Scene segmentation
- Image classification



Images from Erik Sudderth (left), wikipedia (right)

Robotics

- Robotics
 - Part mech. eng.
 - Part AI
 - Reality much harder than simulations!
- Technologies
 - Vehicles
 - Rescue
 - Soccer!
 - Lots of automation...
- In this class:
 - We ignore mechanical aspects
 - Methods for planning
 - Methods for control



Images from UC Berkeley, Boston Dynamics, RoboCup, Google

Logic

□ Logical systems

- Theorem provers
- NASA fault diagnosis
- Question answering

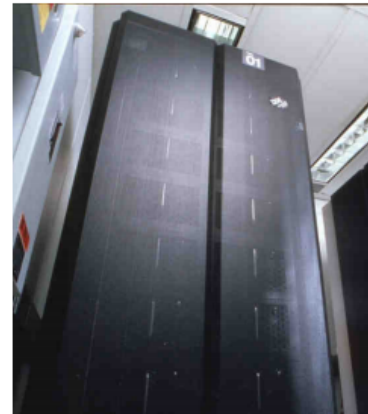
□ Methods:

- Deduction systems
- Constraint satisfaction
- Satisfiability solvers (huge advances!)

Game Playing

- **Classic Moment: May, '97: Deep Blue vs. Kasparov**

- First match won against world champion
- “Intelligent creative” play
- 200 million board positions per second
- Humans understood 99.9 of Deep Blue's moves
- Can do about the same now with a PC cluster



- **Open question:**

- How does human cognition deal with the search space explosion of chess?
- Or: how can humans compete with computers at all??

- **1996: Kasparov Beats Deep Blue**

“I could feel --- I could smell --- a new kind of intelligence across the table.”

- **1997: Deep Blue Beats Kasparov**

“Deep Blue hasn't proven anything.”

- **Huge game-playing advances recently, e.g. in Go!**

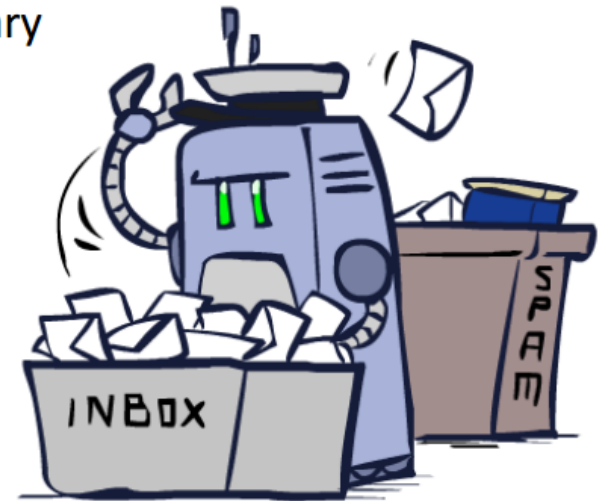


Text from Bart Selman, image from IBM's Deep Blue pages

Decision Making

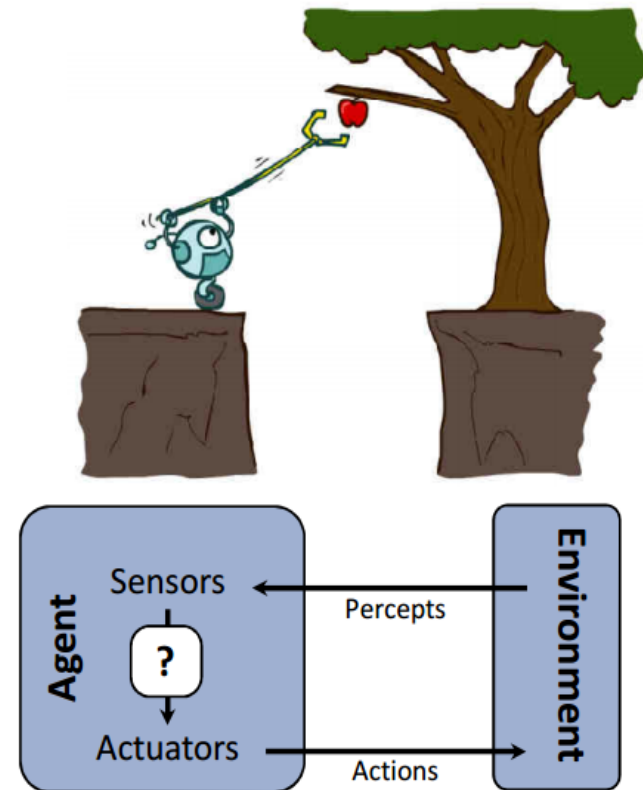
- Applied AI involves many kinds of automation

- Scheduling, e.g. airline routing, military
- Route planning, e.g. Google maps
- Medical diagnosis
- Web search engines
- Spam classifiers
- Automated help desks
- Fraud detection
- Product recommendations
- ... Lots more!



Designing Rational Agents

- An **agent** is an entity that *perceives* and *acts*.
- A **rational agent** selects actions that maximize its (expected) **utility**.
- Characteristics of the **percepts**, **environment**, and **action space** dictate techniques for selecting rational actions
- **This course** is about:
 - General AI techniques for a variety of problem types
 - Learning to recognize when and how a new problem can be solved with an existing technique



Course Topics

❑ Part I: Reasoning under Uncertainty

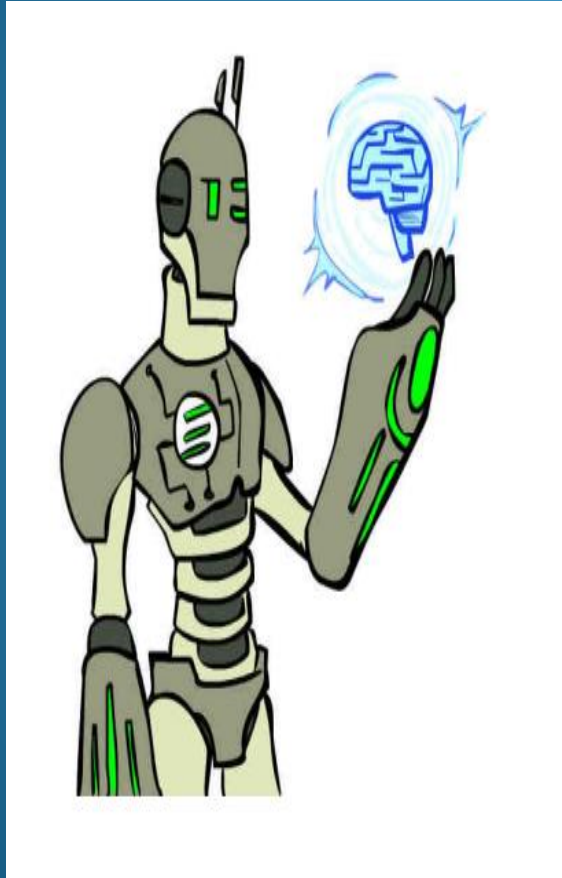
- Machine learning
- Expert Systems
- Decision Theory

❑ Part II: Making Decisions

- Search techniques
- Constraint satisfaction
- Uncertain search

❑ Part III: Throughout: Applications

- Natural language, Computer vision, robotics, games,....



Thanks

Dr Sherin ElGokhy